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Abstract

USE OF POWERFUL RADIATION SOURCES IN CHEMICAL INVESTIGATIONS

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The paper gives a survey of results obtained in the USSR during the last 2-3 years in different branches of radiation chemistry.

It is concerned first with advances in the investigation of elementary processes and in general theory, dealing mainly in the field of gas phase processes with mass-spectrometric studies of ion-molecular reactions and dissociation of excited ions, in the condensed state with the transfer of excitation energy and direct investigation of ions and radicals. New effects in energy transfer through triplet state have been revealed, correlating electronic excitation levels and radiation stability. Electromagnetic interaction in excitation transfer has been considered and a concept of "orientons" advanced. A greater part, than supposed earlier, is shown to be played by ions and ion-radicals in the condensed phase. Theoretical concepts of processes limiting the accumulation of frozen radicals and other active particles under irradiation have been developed.

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By ESR and kinetic methods new data have been obtained concerning the nature and reactions of primary particles in the radiolysis of water. A quantitative study of radical diffusion and recombination permitted to explain regularities in the formation of molecular products and to estimate the size of spurs and the initial radical distribution.

Investigations of radiation-induced solid state polymerization of different monomers demonstrate an exceptional influence of the phase state. A number of processes are proved to occur directly in the solid, with considerable kinetic effects in the range of phase transitions. Probable mechanisms of polymerization in the crystalline and glass state are discussed. Considerable catalytic action of p-type semiconducting oxides upon the low-temperature polymerization of acrylonitrile, methyl metacrylate, etc. and a selective action of p- and n-type oxides on the propagation of anionic and cationic chains are demonstrated.

New possibilities in gas phase graft polymerization have been demonstrated, such as synthesis of organo-mineral materials, formation of combined fibres with oriented grafted layer, etc. Radiation-induced vulcanization of special types of rubbers permitted to obtain substances with unique properties. Processes based on radiation-induced curing of tyres and cross-linking of plastics, have been developed.

Effects occurring in polymers specifically during irradiation have been discovered and investigated, viz. reversible changes in mechanical properties and diffusion rate, some saturation phenomena, etc.

By means of combined irradiation and pyrolysis of some polymers, organic semi-conductors with controlled electrophysical properties varying in a wide range have been obtained.

Catalytic and other reactions, occurring under irradiation in heterogeneous systems, are reported, with special attention to processes in the adsorbed layer.

Possibilities of utilizing, in the tracks or by way of overall temperature increase, the heat released in nuclear reactions for endothermic chemical processes are discussed.